

Notes on some Arctic Comatulæ. By P. HERBERT CARPENTER,
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(PLATE II.)

THE object of this paper is to endeavour to clear up some of the uncertainty which appears to exist in the minds of those naturalists who have had occasion to study the Arctic Comatulæ, respecting the characters of one or two widely distributed species, and more especially that which was described by Duncan and Sladen under the name of *Antedon prolixa* *. It has been recently regarded as only a full-grown and highly developed form of the small *Antedon tenella*, Retzius, sp., which is better known to European naturalists under the name of *Antedon Sarsii*; but I hope to show that this view is incorrect, and only results from an imperfect acquaintance with the characters of the last mentioned type. The validity of another Arctic species, that which I have called *Antedon quadrata*, has also been challenged, owing to the resemblance between its younger stages and those of *Antedon Eschrichti*, though more mature individuals of the two types have seemed very distinct to those who have compared them directly.

One, if not both, of these disputed species, *Antedon quadrata* and *A. prolixa*, was discovered by the 'Porcupine' in 1869 in the cold area of the Faroe Channel; but they remained without notice for some years. In 1872-3, however, they were both obtained by the ill-fated 'Tegetthoff' in the neighbourhood of Nova Zembla and Franz Joseph Land respectively; and they were referred by von Marenzeller † to *Antedon celtica*, Barrett, and *A. Sarsii*, Düben and Koren. Their subsequent history may be summarized as follows:—

Specimens obtained

by:—

1877. The 'Tegetthoff.'	{	A. Referred to <i>Antedon celtica</i> , Barrett, by von Marenzeller.
	}	B. Referred to <i>A. Sarsii</i> by von Marenzeller.

* 'A Memoir on the Echinodermata of the Arctic Sea to the West of Greenland' (London, 1881), p. 77.

† "Die Cœlenteraten, Echinodermen und Würmer der k. k. Oesterreichisch-Ungarischen Nordpol-Expedition," Denkschr. d. k. Akad. d. Wiss. Wien, 1877 [1878], Bd. xxxv. pp. 380-382.

Specimens obtained.

1881. H.M.S. 'Alert' { A. Referred to *A. celtica*, Barrett, by Sladen.
B. Described as *A. proluxa* by Sladen.
1882. Originals of *Antedon celtica*, Barrett, referred to *A. phalangium* by Carpenter.
1883. The 'Tegetthoff' ... A. }
H.M.S. 'Alert' A. } Described as *A. quadrata* by Carpenter.
H.M.S. 'Triton' ... A. }
H.M.S. 'Valorous' . A. }
1883. H.M.S. 'Porcupine' B. } Referred to *A. dentata* (*Sarsii*, auct.) by
H.M.S. 'Triton' ... B. } Carpenter.
1883. H.M.S. 'Porcupine' C. } Described as *A. hystrix* by Carpenter.
H.M.S. 'Triton' ... C. }
1885. The 'Vöringen' ... A. Referred to *A. celtica* by Nansen.
1886. *Antedon quadrata*, Carpenter, referred to *A. Eschrichti* by Levinson.
1886. The 'Willem Barents' { A. Referred to *A. quadrata* by Carpenter.
B. Referred to *A. dentata* by Carpenter.
1886. The 'Tegetthoff' ... A.)
H.M.S. 'Alert' A.)
H.M.S. 'Triton' ... A.) Referred to *A. quadrata* by Fischer.
And those from Jan
Mayen A.)
1886. The 'Tegetthoff' ... B.)
H.M.S. 'Alert' B.) Referred to *A. dentata* by Fischer.
And those from Jan
Mayen B.)
1887. The 'Varna' { A. Referred to *A. quadrata* by Carpenter.
B. Referred to *A. proluxa* by Carpenter.
1888. The 'Tegetthoff' ... A.)
H.M.S. 'Alert' A.)
H.M.S. 'Triton' ... A.)
H.M.S. 'Valorous' . A.) Referred to *A. quadrata* by Carpenter.
The 'Willem Barents' A.)
The 'Varna' A.)
And those from Jan
Mayen..... A.)
1888. The 'Tegetthoff' ... B.)
H.M.S. 'Alert' B.)
The 'Vöringen' ... A.) Referred to *A. proluxa* by Carpenter.
The 'Varna' B.)
And those from Jan
Mayen... B.)
1888. H.M.S. 'Porcupine' B. } Referred to *A. tenella* (= *A. dentata* = *A.*
H.M.S. 'Triton' ... B. } *Sarsii*) by Carpenter.
The 'Willem Barents' B. }
1888. H.M.S. 'Porcupine' C. } Referred to *A. hystrix* by Carpenter.
H.M.S. 'Triton' ... C. }

1. *Antedon quadrata* *, *Carpenter*.

Levinsen † has recently denied the distinctness of this species from *Antedon Eschrichti* on the ground that its characters, as stated by von Marenzeller and Sladen, and in my own preliminary description, all present themselves in immature examples of *A. Eschrichti*. He has not, however, seen any authentic specimens of it, so that he has not had the opportunity of comparing them with equal-sized but still immature examples of *A. Eschrichti*. This I have been able to do, as explained in my Report on the 'Challenger' Comatulæ ‡; and I am still inclined to agree with Sladen in keeping the two species distinct. He is the only other naturalist besides myself who has had the means of directly comparing mature examples of the two species which were obtained at the same locality; and neither von Marenzeller nor Sladen ever seem to have had any suspicion that the forms which they were describing as *Antedon celtica* might be young examples of *A. Eschrichti*. Neither do I think that this view would occur to any one familiar with *A. Eschrichti* who examined the fine specimen of *A. quadrata* obtained by the 'Varna' in the Kara Sea §, the general facies of the two forms being altogether different.

2. *Antedon prolixa*, *Sladen*. (Plate II. figs. 1-4, 6.)

Fjeldsen's dredgings at Discovery Bay during Sir George Nares's Arctic Expedition of 1875-76 yielded some specimens of an *Antedon* which Sladen took to be new; but, as we shall see subsequently, it had been already obtained, though not described, both by the 'Porcupine' and by the 'Tegetthoff.' Sladen gave a careful diagnosis of the type under the specific name *prolixa* ||; and when the 'Varna' Comatulæ from the Kara Sea came into my hands I found two examples of this form among them ¶.

In the following year Dr. Fischer published his account of the Echinoderms which he had collected at the Austro-Hungarian

* The synonymy of this species will be found on p. 149 of the Report on the 'Challenger' Comatulæ.

† "Kara-Havets Echinodermata," *Dijmphna-Togtets zoologisk-botaniske Udhytte*, Kjöbenhavn, 1886, p. 413.

‡ *Zool. Chall. Exp.* vol. xxvi. 1888, pp. 150-156.

§ "Zoölogische Bijdragen tot de Kennis der Karazee: II. Report on the Comatulæ," *Bijdragen tot de Dierkunde*, 1887, 14. Afl. p. 42. fig. 1.

|| *Op. cit.* p. 77.

¶ 'Report on the Comatulæ of the Kara Sea,' p. 44, figs. 2, 3.

Polar station in Jan Mayen, the principal Crinoid occurring there being a large *Antedon* which he referred at once to *A. proluxa* *. He also obtained a second, but less mature individual, two others quite young, and two Pentacrinoids, which last "vollkommen mit den Beschreibungen übereinstimmen, die Sars in seinen 'Mémoires des Crinoïdes vivants' gibt, und auf Taf. v. und vi. abbildet. Die von Jan Mayen mitgebrachten Exemplaren entsprechen dem Entwicklungsstadium, wie es Sars auf Taf. v. fig. 9 entwirft." The figure referred to represents, I need hardly say, the Pentacrinoid stage of *Antedon Sarsii*, now known as *A. tenella* †; and we shall have to consider later on whether the correspondence between the Jan Mayen larvæ and those of *A. tenella* really is so complete as Fischer supposed. He also states that the two young specimens mentioned above "tragen sämtliche von Düben & Koren und den späteren Autoren für *Antedon Sarsii* angegebenen charakteristischen Merkmale;" but he does not seem to have ever directly compared them with examples of this well-known Scandinavian type, of which the Vienna Museum possesses numerous examples. This would have been a more satisfactory means of identification than the use of descriptions written over forty years ago and, as is only natural, insufficient for the purposes of specific discrimination in these later times. But although Fischer neglected to compare his youngest individuals from Jan Mayen with typical examples of *Antedon tenella*, he did compare his two largest individuals of *A. proluxa* with the two specimens from the 'Tegetthoff' Expedition which von Marenzeller had considered to be large examples of *A. Sarsii (tenella)*, having longer cirri with more numerous joints than the typical Scandinavian form. He was good enough to send them to me for examination early in 1881, and at that time I did not see how otherwise to regard them, as I had not then seen *A. proluxa*, and the possibility of their being immature forms of this type did not occur to me, though I now know that such is the case.

Fischer, therefore, relying upon the identification by von Marenzeller and myself of the two 'Tegetthoff' specimens with *Antedon Sarsii (tenella)*, and finding his two largest examples of *A. proluxa* from Jan Mayen to agree closely with the former pair, naturally concluded that the latter should also receive the same

* "Echinodermen von Jan Mayen," Die Oesterreichische Polarstation Jan Mayen, Bd. iii. 1886, p. 29.

† See the Report on the 'Challenger' Comatulæ, p. 172.

name; and he was strengthened in this opinion by his comparison of the two youngest individuals from Jan Mayen and also of the Pentacrinoids with the descriptions of *A. Sarsii* and its larva. He expressed his conviction, therefore, "dass unter *Antedon prolixa*, Sladen, nur ausgewachsene Exemplare von *A. Sarsii*, welche bislang noch nicht erschöpfend beschrieben waren, zu verstehen sind."

Under these circumstances it seemed desirable that the characters of these two species should be re-investigated, and direct comparisons made of all the available material. The types of *Ant. prolixa* are in the National Collection, while the two examples of it obtained by the 'Varna' in the Kara Sea are still in my keeping, together with numerous specimens of *A. Sarsii* (*tenella*) obtained by the 'Porcupine,' 'Triton,' 'Blake,' 'Willem Barents,' &c.; while, thanks to the kindness of Dr. von Marenzeller, I have been enabled to compare these individuals with the two original 'Tegetthoff' specimens, and also with all those obtained by Dr. Fischer at Jan Mayen. Careful investigation of all this material has convinced me that *Antedon prolixa* is a good species, and quite distinct from *A. tenella*. Both the two 'Tegetthoff' specimens and also Sladen's types are immature individuals, Fischer's largest example from Jan Mayen (Pl. II. fig. 4) being the first fully grown one yet obtained. Since seeing this, too, I have no longer any doubt that the *Antedon hystrix* which was dredged by the 'Porcupine' and 'Triton' in the cold area of the Faroe Channel, and by the Norwegian North-Atlantic Expedition from 743 fathoms near Spitzbergen*, should also be referred to *A. prolixa*, a possibility which I mentioned when discussing *A. hystrix* in the 'Challenger' Report †.

The two specimens dredged by the 'Porcupine' in 1869 thus prove to be the first discovered individuals of *A. prolixa*; but neither they nor those from the 'Tegetthoff' were recognized as new to science at the time; and the species was first described by Sladen from the less mature individuals brought home by Sir George Nares's Arctic Expedition of 1875-76.

The essential points of difference between *Antedon prolixa* and

* This is the *Antedon celtica* mentioned by Nansen in his 'Bidrag til Myzotomernes Anatomi og Histologi,' Bergen, 1885, p. 6. I am indebted to the kindness of Dr. Nansen for specimens of the type, dredged by the 'Vöringen.

† *Op. cit.* p. 167.

A. Sarsii (tenella) are as follows:—1, Size; 2, the Cirri; 3, the Radials; 4, the Shape of the Arm-joints; 5, the Syzygies.

1. The Scandinavian variety of *Antedon tenella* is much smaller and less robust than that found in the deeper water of the Atlantic, both east and west. The examples dredged by the 'Blake' off the New England coast are the largest which I have seen; but the disk is not more than 7 mm. in diameter, while the maximum length of an arm scarcely reaches 70 mm. On the other hand, Fischer's largest individual of *A. proluxa* from Jan Mayen has a disk 10 mm. in diameter, and he measured one arm as 120 mm. long, adding "Es fehlt jedoch ein gutes Stück von der Spitze des Armes." This difference in size between the two types would, of course, be unimportant alone; but taken together with those other differences now to be described, it may, I think, be regarded as affording a good specific character.

2. The Scandinavian variety of *Antedon tenella* usually has but 18 or 20 cirrus-joints, while there may be 25 in those from the Faroe channel and Kara Sea, and 28 or 30 in the American variety, with a maximum length of 24 mm. These dimensions are very different from those of the individuals which have been referred to *A. proluxa*, as will be seen from the following Table:—

Antedon tenella Longest cirri of American variety 24 mm., with 30 joints.
(*Sarsii*, auct.).

Antedon proluxa.

'Tegetthoff'	Longest cirri.....	37 mm., with 33 joints.
Jan Mayen	Longest cirri.....	60 mm., with 43 joints.
Sladen's types.....	Longest cirri.....	60 mm., with 45 joints.
'Porcupine'	Longest cirri.....	50 mm., with 45 joints.
'Varna' (immature).	Longest cirri.....	35 mm., with 35 joints.
'Vöringen'	Longest cirri.....	35 mm., with 40 joints.
A specimen from Finmark in the British Museum	Longest cirri.....	35 mm., with 41 joints.

See also the measurements given on p. 176 of the Report on the 'Challenger' Comatula.

3. If Fischer be right in his supposition that *Antedon proluxa* is merely the fully grown form of *A. Sarsii (tenella)*, one would of course expect that the individuals referred to the latter type

would present more embryonic characters than those of *A. proluxa*. This, however, is exactly contrary to the real state of the case. Both the calyx and the arm-joints of *A. tenella* exhibit characters of greater maturity than equal-sized or even larger examples of *A. proluxa*. Thus, for example, in the large Atlantic variety of *A. tenella* the radials are barely visible (Pl. II. fig. 7); and they are only traceable in younger individuals as a narrow band round the edge of the centro-dorsal (fig. 6). But this is much broader in the calyx of the nearly equal-sized but still immature *A. proluxa* from the 'Tegetthoff' expedition (fig. 2); so that it presents an appearance similar to that of the embryonic types *A. abyssicola* and the genus *Atelecrinus*. Even in the larger 'Tegetthoff' specimen, which is of much greater size than any *Antedon tenella* I have ever seen, a considerable portion of the radials appears externally, and the full-grown *A. proluxa* from Jan Mayen (fig. 4) shows more of them than the largest *A. tenella* of the 'Blake' dredgings, though the latter is absolutely of much smaller size (fig. 7).

4. What has been said above concerning the radials holds good also for the costals and lower brachials, which are relatively longer and more embryonic in the immature *A. proluxa* than in the largest and best-developed individuals of *A. tenella*. This difference, however, is most apparent when the two young specimens of *A. proluxa* from Jan Mayen are compared with equal-sized examples of *A. tenella* from the North Sea. Fischer states that the former present all the characters which are given by Düben and Koren and later authors as characteristic of *A. Sarsii*. But Düben and Koren's description of this type is over forty years old, and not of much value therefore for systematic purposes at the present time, while subsequent writers have added little of importance to it. A direct comparison of Fischer's two specimens with typical examples of *A. tenella* leads to very different results. Their cirri are considerably larger than those of a Scandinavian form of equal size which has well-developed genital glands and all the other characters of maturity. Its radials are almost entirely concealed, while in Fischer's specimens a considerable portion of them is visible, as described above. Similar differences appear between the lower brachials of the two forms, as will be evident from a glance at figs. 3 and 5 on Plate II. Those of the young *A. proluxa* are much elongated, and present all the characters of immaturity; while in the arm of *A. tenella* of

the same size the joints are as wide or wider than long, and present the shape characteristic of the adult individual. The difference is so marked, that Fischer can hardly have overlooked it, if he really did compare the two types; and it indicates very clearly that *A. proluxa* and *A. tenella* are by no means so closely identical as he supposes.

5. The length of the syzygial intervals throughout the arms is also very different in the two forms. I have carefully examined a large number of arms of *A. tenella* from many different localities; and I find that after the third syzygy, which is almost invariably in the twelfth brachial, the syzygial interval is normally only two joints. The second interval may sometimes be two instead of three, and more rarely four; so that the third syzygy comes on the 11th or 13th, instead of on the 12th brachial; but the remaining syzygies occur almost invariably on every third joint. The interval is sometimes, though rarely, increased to three joints; but I have never found it rising to four or five, as mentioned in Müller's description of the type*. In three of the longest unbroken arms which I have met with the succession of intervals was—

2 2 2 2 2 2 2 2 2 2 2 2 2 2 or 2^{15} ,
 2 2 2 2 2 2 2 2 2 3 2 2 2 2 or 2^{10} , 3, 2^4 ,
 2 2 2 3 2 2 2 2 2 2 2 2 2 2 or 2^3 , 3, 2^{11} .

I have also examined twenty specimens of *A. proluxa* from seven different localities, and have recorded the sequence of the syzygies in the five longest arms remaining to each. I find that the syzygial interval is generally 3 joints, but may sometimes be 4, 5, or 6; so that the third syzygy may come anywhere from the 12th to the 15th brachial. The following intervals may be of 1-6 joints, 3 being by far the most frequent, sometimes occurring sixteen times in succession, though intervals of 2 joints are not uncommon, especially in the first third of the arms. The following Table shows the distribution of the syzygies in the different groups of individuals which I have examined.

* "Ueber die Gattung *Comatula*, Lam., und ihre Arten," Abhandl. d. k. Akad. d. Wiss. Berlin [1847], 1849, p. 254.

	Sladen's types.	'Porcu- pine.'	'Vöringen.'	Kara Sea ('Varna' & Finmark).	'Tegett- hoff.'	Jan Mayen.	Total.
No. of individuals :	5	3	5*	3	2	2	20
Interval of							
1 joint	0	0	6	3	0	4	13
2 joints	32	26	150	55	39	53	355
3 joints	64	78	192	63	65	102	564
4 joints	4	22	53	17	5	1	102
5 joints	1	7	19	7	0	0	34
6 joints	0	2	2	0	0	0	4

Typical Arms.

3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3, or 3¹⁶, 2, 3,
 4 5 4 4 4 4 5 6 5 4 3 5 4 4 4 2 5,
 3 4 3 4 4 5 5 5 3 3 4 3 4 3 3,
 2 3 3 2 3 4 3 5 2 3 5 4 2 4,
 2 2 2 3 2 2 2 3 2 2 2 3 2 3 2 5 3 4 2 3.

From these data it may, I think, be fairly concluded that the typical number of joints in the syzygial intervals of *Antedon prolixa* is 3, as in *A. Eschrichti*; while in *A. tenella* there are not more than 2, as in the allied species *A. exigua*. This character, taken in connection with those of the cirri, radials, and arm-joints, serves to distinguish the two species very clearly; and I see no reason for uniting them, as Fischer has done.

He supports his views by remarking* :—" Sollten noch irgend welche Zweifel entstehen, so werden dieselben wiederlegt durch die Thatsache, dass ich gleichzeitig mit den bereits beschriebenen Exemplaren zwei *Pentacrinus*-Stadien auf einer *Rhynconella* aufsitzend fand, die vollkommen mit den Beschreibungen übereinstimmen, die Sars in seinen 'Mémoires des Crinoïdes vivants' gibt, und auf Taf. v. und vi. abbildet. Die von Jan Mayen mitgebrachten Exemplare entsprechen dem Entwicklungsstadium, wie es Sars auf Taf. v. fig. 9 entwirft." An enlarged view of the head of this individual is given by Sars in fig. 11 of the same plate, which I have copied on Plate II. fig. 8, in order to compare it with the Jan Mayen larva, which Dr. von Marenzeller has kindly sent me for examination (fig. 1). They are, as Fischer remarks, at the

* *Loc. cit.*, p. 30.

same stage of development, with the first whorl of cirri just forming; but I cannot see the complete correspondence between the two on which he lays so much stress. Sars gave the dimensions of his larva as follows:—

Stem of 49 joints 21 mm. long.

Head and 18–20 arm-joints 4 ,,

His figure also shows the first costals to be nearly square, and the axillary longer than wide, while the cirri are quite rudimentary, only just reaching above the basi-radial suture (fig. 8). Now in the Jan Mayen larva one cirrus at least is much better developed, having well-defined joints, and almost reaching up to the level of the first brachials; while the costals present characters of much greater maturity, the first being oblong and the axillaries wider than long (Pl. II. fig. 1). It is altogether more robust than the larva of *A. tenella*, as the following measurements show:—

Stem-fragment of 26 joints 14 mm. long.

Head and 8 arm-joints 4 ,,

This greater robustness at the same developmental stage is, of course, only to be expected if the Jan Mayen larva belongs to *A. proluxa*, which reaches such a much larger size than *A. tenella* in the adult condition; while, as was pointed out on pp. 177–178 of the ‘Challenger’ Report, there is a fallacy in Fischer’s argument respecting these Pentacrinoids, which altogether vitiates his conclusions as to the identity of *A. tenella* and *A. proluxa*. I am well acquainted with the various developmental stages of *A. tenella*, and should certainly not refer the Jan Mayen larva to this species. It is, however, very closely similar to a larva dredged by the ‘Porcupine’ in the cold area of the Faroe Channel, which I figured in the ‘Challenger’ Report*. The first costals of this larva are oblong, and the axillaries wider than long; while its measurements are as follows:—

Stem-fragment of 30 joints 20 mm. long.

Head and 10 arm-joints 4 ,,

This ‘Porcupine’ larva and that from Jan Mayen undoubtedly belong to the same species. The former is quite different from the Pentacrinoids of *Antedon tenella* and *A. Eschrichti*, which were dredged in the same locality; and I was therefore led to refer it

* *Op. cit.* pl. xiv. fig. 3.

to *Antedon hystrix*, which is also an inhabitant of the cold area. But this species now turns out to be identical with *Antedon proluxa*; and the resemblance of the 'Porcupine' larva to that found at Jan Mayen, together with the adult *A. proluxa*, is therefore an important piece of evidence against Fischer's identification of *Antedon proluxa* with *A. tenella*.

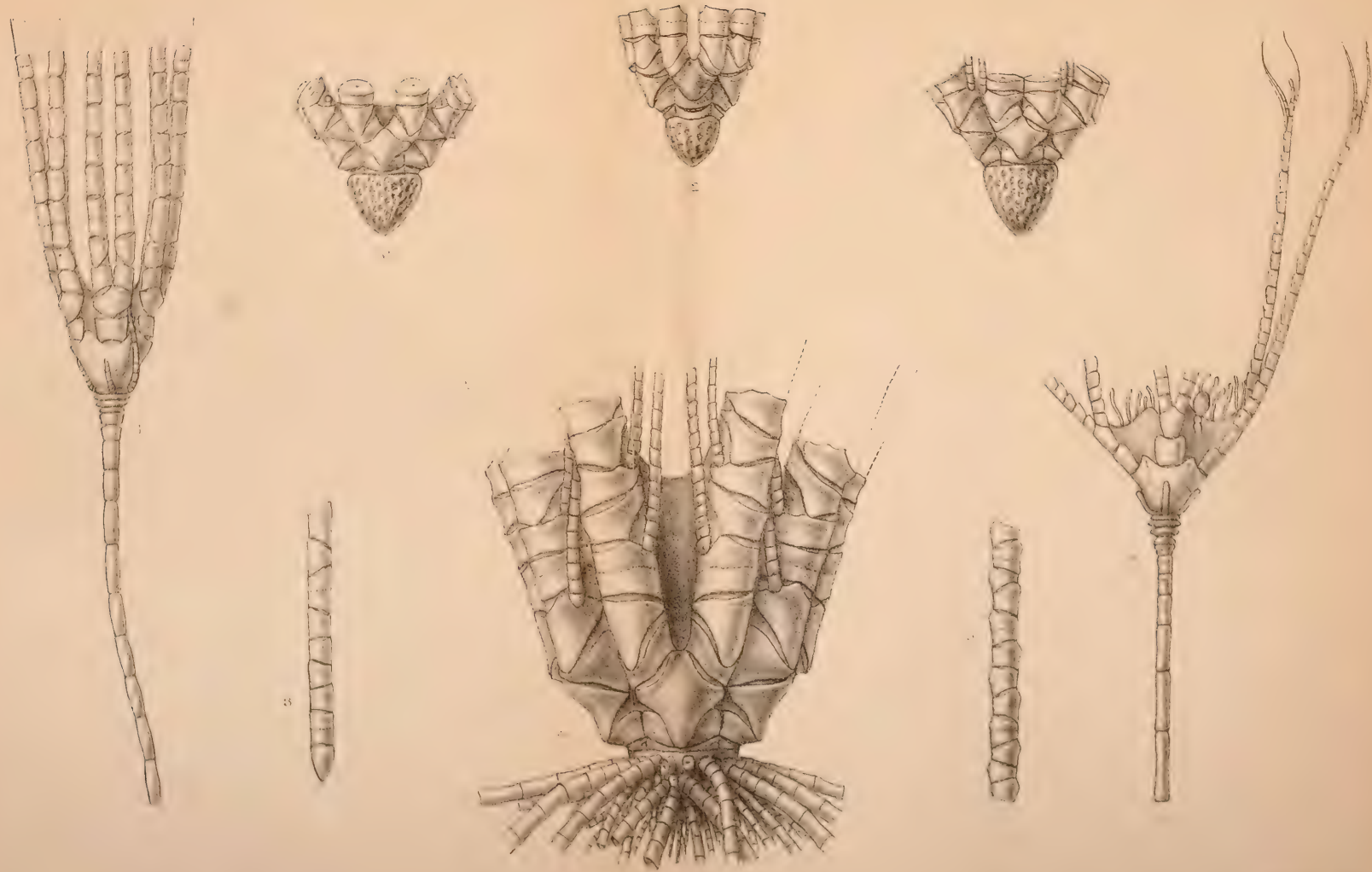
SUMMARY.

<p><i>Tenella</i>, Retzius, = <i>dentata</i>, Say, = <i>Sarsii</i>, Düben & Koren.</p> <p>H.M.S. 'Porcupine,' B. H.M.S. 'Triton,' B. The 'Willem Barents,' B.</p>	<p><i>Proluxa</i>, Sladen, = <i>hystrix</i>, Carpenter, = <i>celtica</i>, Nansen.</p> <p>H.M.S. 'Porcupine,' C. The 'Tegetthoff,' B. H.M.S. 'Alert,' B. H.M.S. 'Triton,' C. The 'Varna,' B. The 'Vöringen,' A. Those from Jan Mayen, B. A specimen from Finmark in the British Museum.</p>	<p><i>Quadrata</i>, Carpenter, = <i>celtica</i>, Marenzeiler.</p> <p>The 'Tegetthoff,' A. H.M.S. 'Valorous,' A. H.M.S. 'Alert,' A. H.M.S. 'Triton,' A. The 'Willem Barents,' A. The 'Varna,' A. Those from Jan Mayen, A.</p>
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EXPLANATION OF PLATE II.

- Fig. 1. Pentacrinoid of *Antedon proluxa*, from Jan Mayen. ×10.
2. Calyx and arm-bases of an immature *A. proluxa*, from the 'Tegetthoff' expedition. ×4.
 3. Portion of an arm of a young *A. proluxa* from Jan Mayen. (Br. 2-10). ×6.
 4. Full-grown individual of *A. proluxa*. ×4.
 5. Portion of an arm of *A. tenella*. (Br. 5-16). ×6.
 6. Calyx and arm-bases of an immature *A. tenella*, from the West Atlantic. ×4.
 7. Calyx and arm-bases of a full-grown individual from the same locality. ×4.
 8. Pentacrinoid of *A. tenella*. Copied from Sars.
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Comatula



Boysen & Huxley del et lith

ARCTIC COMATULA.